Claims

1. A circuit unit comprising at least an insulating carrier substrate (1) on which a conductive, flat coil (3) is located, and an integrated circuit (7) whose connection points (27) are electrically connected with the coil ends (15, 19) directly or via contacts (25) or coupled capacitively therewith, **characterized** in that coil layers (9, 17) and insulating layers (11) are applied alternately to the insulating substrate (1), each insulating layer having at least one opening (13) through which the adjacent coil layers (9, 17) are electrically interconnected, or the adjacent coil layers (9, 17) being coupled capacitively, so that the individual coil layers (9, 17) yield a coil (3).

2. The circuit unit of claim 1, characterized in that the at least one opening (13) in the insulating layer (11) leads to one end of the coil layer (9) covered by the insulating layer (11), and this end of the coil layer (9) is electrically connected with one end of the coil layer (17) located on the insulating layer (11) through the at least one opening (13) in the insulating layer (11).

3. A circuit unit comprising at least an insulating carrier substrate (1) on which a conductive, flat coil (3) is located, and an integrated circuit (7) whose connection points (27) are electrically connected with the coil ends (15, 19) directly or via contacts (25), **characterized** in that the circuit unit has at least one relief embossing field (37) in the area of which characters are embossable on the circuit unit, and the dimensions and/or the arrangement of turns of the coil on the substrate (1) are selected so that the coil (3) is not completely severed during embossing of the characters.

4. The circuit unit of claim 3, characterized in that at least one turn (39) of the coil runs between the relief embossing field (37) and the edge of the substrate (1).

5. The circuit unit of any of claims 3 to 4, characterized in that the turns (41) of the coil are wider in the area of the relief embossing field (37) than the size of the embossed characters.

6. The circuit unit of any of claims 3 to 5, characterized in that the turns (43) of the coil run between successive lines of the relief embossing field (37).

7. The circuit unit of claim 6, characterized in that the turns (43) of the coil are wider in the area of the relief embossing field (37) than the distance between successive lines.

8. The circuit unit of claim 3, characterized in that the material properties of the coil (3) are adapted to the substrate (1) at least in the area of the relief embossing field (37) in such a way that no cracks inadmissibly impairing the function of the coil (3) arise in the coil material during embossing of the characters.

9. The circuit unit of claim 8, characterized in that the coil (3) consists of conductive plastic.

10. The circuit unit of any of claims 1 to 9, characterized in that the coil (3) is printed on the insulating substrate (1) or on the insulating layers (11).

11. A chip card, characterized in that it has the circuit unit of any of claims 1 to 10.

Sub. A

12. A method for producing a circuit unit comprising an insulating carrier substrate (1) on which a conductive coil (3) is located, and an integrated circuit (7) whose connection points (27) are electrically connected with the coil ends (15, 19) directly or via contacts (25), characterized by the following method steps:

a) applying a coil layer (9) with at least one turn to the substrate (1),

b) covering at least the area of the applied coil layer (9) with an insulating layer (11) containing at least one opening (13) through which at least one of the covered turns of the coil layer (9) is accessible,

c) applying to the insulating layer (11) a further coil layer (17) with at least one turn which is electrically connected with the previously covered coil layer (9) through the at least one opening (13),

d) optionally repeating method steps b) and c) once or several times,

e) electrically connecting the connection points (27) of the integrated circuit (7), or the contacts (25) of a module (23) containing the integrated circuit (7), with one end (15) of the coil layer (9) located directly on the insulating substrate (1), on the one hand, and with one end (19) of the last applied coil layer (17), on the other hand.

13. The method of claim 12, characterized in that the electric connection between the coil layers (9, 17) takes place through the at least one opening (13) in the insulating layer (11) by laminating the insulating layer (11) or insulating layers (11) and the insulating substrate (1).

14. The method of claim 13, characterized in that conductive material (29) is additionally disposed in the area of the at least one opening (13) before lamination.

15. The method of claim 12, characterized in that the at least one opening (13) in the insulating layer (11) is produced before application of at least one of the coil layers (9, 17) separated by the insulating layer (11), and the at least one opening (13) is filled with the coil material during application of at least one of the coil layers (9, 17).

16. The method of claim 12, characterized in that the at least one opening (13) is filled with conductive material (33) after application of the coil layers (9, 17) so as to form an electric connection between the coil layers (9, 17).

17. The method of claim 12, characterized in that a conductive element (35) is transferred to the coil layers (9, 17) in such a way that the conductive element (35) forms an electric connection between the coil layers (9, 17) through the at least one opening (13).

Sub. A cont.

18. The method of claim 12, characterized in that the at least one opening (13) is produced by means of at least one wire (31) piercing the insulating layer (11) and at least partly the coil layers (9, 17) separated by the insulating layer (11), the wire (31) remaining in the insulating layer (11) and at least partly in the coil layers (9, 17) so as to form an electric connection between the coil layers (9, 17).

19. A method for producing a circuit unit comprising an insulating substrate (1) on which a conductive, flat coil (3) is located, and an integrated circuit (7) whose connection points (27) are electrically connected with the coil ends (15, 19) directly or via contacts (25), **characterized** by the steps of:

applying the coil (3) to the substrate (1) in such a way that the distance between the coil ends (15, 19) can be bridged by the connection points (27) of the integrated circuit (7) or by the contacts (25) of a module (23) containing the integrated circuit (7), and

mounting the integrated circuit (7) or the module (23) on the coil ends (15, 19) in such a way that the connection points (27) of the integrated circuit (7) and the coil ends (15, 19) or the contacts (25) of the module (23) and the coil ends (15, 19) touch, and

forming an electric contact between the connection points (27) and the coil ends (15, 19) or the contacts (25) and the coil ends (15, 19) solely through this touching.

20. The method of claim 19, characterized in that the coil (3) is printed on the substrate (1), and the integrated circuit (7) or the module (23) is mounted before the printing material completely dries.

21. A method for producing a circuit unit comprising an insulating carrier substrate (1) on which a conductive, flat coil (3) is located, and an integrated circuit (7) whose connection points (27) are electrically connected with the coil ends (15, 19) directly or via contacts (25), **characterized** by the steps of:

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incorporating the integrated circuit (7) or a module (23) containing the integrated circuit (7) in the substrate (1) in such a way that the connection points (27) of the integrated circuit (3) or the contacts (25) of the module are flush with the surface of the substrate (1),

then applying the coil (3) to the substrate (1) in such a way that the coil ends (15, 19) at least partly cover the connection points (27) or the contacts (25), and

forming an electric contact between the connection points (27) and the coil ends (15, 19) or the contacts (25) and the coil ends (15, 19) solely through this direct touching.

22. The method of claim 21, characterized in that the coil (3) is printed on.

~~23. A chip card,~~ **characterized** in that it has a circuit unit produced according to ~~any of claims 12 to 22~~.

Divisional Application of
Yahya HAGHIRI-TEHRANI et al.

APPENDIX OF CLAIMS

12(Amended Once). A method for producing a circuit unit comprising an insulating carrier substrate (1) on which a conductive coil (3) is located, and an integrated circuit (7) whose connection points (27) are electrically connected with the coil ends (15, 19) directly or via contacts (2S), [characterized by] comprising the following [method] steps:

a) applying a coil [layer] section (9) with at least one turn to the substrate (1),

b) covering at least the area of the applied coil [layer] section with an insulating layer (11) containing at least one opening (13) through which at least one of the covered turns of the coil [layer] section (9) is accessible,

c) applying to the insulating layer (11) a further coil [layer] section (17) with at least one turn which is electrically connected with the previously covered coil [layer] section (9) through the at least one opening (13),

[d) optionally repeating method steps b) and c) once or several times,]

e) electrically connecting the connection points (27) of the integrated circuit (7), or the contacts (25) of a module (23) containing the integrated circuit (7), with one end (15) of the coil [layer] section (9) located directly on the insulating substrate (1), on the one hand, and with one end (19) of the last applied coil [layer] section (17), on the other hand.

13(Amended Once). The method of claim 12, [characterized in that] wherein the electric connection between the coil [layers] sections (9, 17) [takes place] is carried out through the at least one opening (13) in the insulating layer (11) by laminating the insulating layer (11) or insulating layers (11) and the insulating substrate (1).

14(Amended Once). The method of claim 13, including disposing the [characterized in that] conductive material (29) [is additionally disposed] in the area of the at least one opening (13) before lamination.

15(Amended Once). The method of claim 12, including producing [characterized in that] the at least one opening (13) in the insulating layer (11) [is produced] before application of at least one of the coil [layers] sections (9, 17) separated by the insulating [layer] section (11), and filling the at least one opening (13) [is filled] with the coil material during application of at least one of the coil layers (9, 17).

16(Amended Once). The method of claim 12, including filling [characterized in that] the at least one opening (13) [is filled] with conductive material (33) after application of the coil [layers] sections (9, 17) so as to form an electric connection between the coil [layers] sections (9, 17).

17(Amended Once). The method of claim 12, including transferring [characterized in that] a conductive element (35) [is transferred] to the coil [layers] sections (9, 17) in such a way that the conductive element (35) forms an electric connection between the coil [layers] sections (9, 17) through the at least one opening (13).

18(Amended Once). The method of claim 12, including producing [characterized in that] the at least one opening (13) [is produced] by means of at least one wire (31) piercing the insulating layer (11) and at least partly the coil [layers] sections (9, 17) separated by the insulating layer (11), the wire (31) remaining in the insulating layer (11) and at least partly in the coil [layers] sections (9, 17) so as to form an electric connection between the coil [layers] sections (9, 17).

19(Amended Once). A method for producing a circuit unit comprising an insulating substrate (1) on which a conductive, flat coil (3) is located, and an integrated circuit (7) whose connection points (27) are electrically connected with the coil ends (15,19) directly or via contacts (25), [characterized by] comprising the steps of:

applying the coil (3) to the substrate (1) in such a way that the distance between the coil ends (15, 19) can be bridged by the connection points (27) of the integrated

circuit (7) or by the contacts (25) of a module (23) containing the integrated circuit (7), and

mounting the integrated circuit (7) or the module (23) on the coil ends (15, 19) in such a way that the connection points (27) of the integrated circuit (7) and the coil ends (15, 19) or the contacts (25) of the module (23) and the coil ends (15, 19) touch, and

forming an electric contact between the connection points (27) and the coil ends (15, 19) or the contacts (25) and the coil ends (15, 19) solely through this touching.

20(Amended Once). The method of claim 19, including printing [characterized in that] the coil (3) [is printed] on the substrate (1), and mounting the integrated circuit (7) or the module (23) [is mounted] before the [printing material] printed coil completely dries.

21(Amended Once). A method for producing a circuit unit comprising an insulating carrier substrate (1) on which a conductive, flat coil (3) is located, and an integrated circuit (7) whose connection points (27) are electrically connected with the coil ends (15, 19) directly or via contacts (25), [characterized by] comprising the steps of:

incorporating the integrated circuit (7) or a module (23) containing the integrated circuit (7) in the substrate (1) in such a way that the connection points (27) of the integrated circuit (3) or the contacts (25) of the module are flush with the surface of the substrate (1),

then applying the coil (3) to the substrate (1) in such a way that the coil ends (15, 19) at least partly cover the connection points (27) or the contacts (25), and

forming an electric contact between the connection points (27) and the coil ends (15, 19) or the contacts (25) and the coil ends (15, 19) solely through this direct touching.

22(Amended Once). The method of claim 21, [characterized in that the coil (3)

is printed on] wherein the step of applying the coil to the substrate is carried out by printing the coil on the substrate.